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ABSTRACT

Sixteen preschool-age hearing-impaired children were studied to explore the general nature of their cognitive development and to identify relationships between environmental processes and cognitive development. Data were obtained from administration of the Infant Psychological Development Scale and the Inventory of Home Stimulation (when Ss were 23- to 38-months old); and from administration of the Home Inventory, the Utah Test of Language Development, a structured mother-child interaction task, and a classification task (when Ss were 36- to 54-months-old). Findings revealed that the early cognitive development of deaf children through what J. Piaget terms the sensori-motor stage proceeds quite normally, but that cognitive development which is more clearly dependent on verbal interaction with the environment, or what Piaget terms social transmission, does show a discrepancy when deaf children are compared to hearing children on the classification task. Results suggested that early intervention programs with deaf children need to focus on improving communication abilities and developing curriculum materials which better teach those concepts usually transmitted through social interaction with the environment. (LS)

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COGNITIVE DEVELOPMENT IN YOUNG DEAF CHILDREN

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RESEARCH, DEVELOPMENT AND DEMONSTRATION CENTER IN EDUCATION OF HANDICAPPED CHILDREN

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The University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children has been established to concentrate on intervention strategies and materials which develop and improve language and communication skills in young handicapped children.

The long term objective of the Center is to improve the language and communication abilities of handicapped children by means of identification of linguistically and potentially linguistically handicapped children, development and evaluation of intervention strategies with young handicapped children and dissemination of findings and products of benefit to young handicapped children.

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INTRODUCTION

A delay in some areas of cognitive development has been well documented for deaf children of school age and older (Oléron & Herren, 1961; Furth, 1966; Suppes, 1972; Best, 1972). However, little or no work has been done on cognitive development of preschool age hearing impaired children. A study of this sort is important for two reasons. First, early programs for the hearing impaired are becoming prevalent in the public schools and research on early cognitive development is necessary in order to plan a comprehensive school experience for the hearing impaired child. Second, Piagetian theory postulates that language development is in part based on the early cognitive development of children (Sinclair, 1969, 1971), thus it is necessary to discover whether or not young hearing impaired children in their first two years of life are developing the cognitive base required for later language development.

The focus of this study was twofold: to explore the general nature of cognitive development in young hearing impaired children, and to identify relationships between environmental processes and cognitive development. More specifically, the questions being asked included the following: Is a delay in cognitive development evident for hearing impaired children between the ages of two and five; If so, when does this delay occur?; In what areas does this delay occur?; Do environmental variables such as level of environmental stimulation and maternal interaction patterns affect the cognitive development of the young deaf child? Due to the lack of previous

research in the area and the limited number of subjects available, the current study was planned as an exploratory rather than a definitive work. It is hoped that suggestive findings will be followed up in later research.

LITERATURE REVIEW

As was stated above, there has been no previous research which dealt specifically with the problem under investigation in this study, however, there are several bodies of related research which will be reviewed here.

Piaget's Theory of Cognitive Development

According to Piaget (1969), in the first two years of life, the child completes the stage of sensori-motor development. During this period, the child develops certain structures which will be crucial to later developing modes of thought. Among the things he learns are an elementary understanding of gravity, causality, spatial and object relations, appropriate social behavior, and problem solving abilities. Furthermore, Piaget postulates that it is the child's direct interaction with the environment, and the feedback he receives from this interaction that results in completion of the sensori-motor period of development. Other factors such as maturation and the social transmission of information also play a role in the young child's development but these are not as important to the child in the sensori-motor period as is direct action upon the surroundings. Thus, a child with a normal maturation rate exposed to an environment where certain

things exist or occur will proceed normally through sensori-motor development. Environmental factors which might be postulated to influence sensori-motor development would be such things as an organized home life where certain happenings are regularly followed by other events thus giving the child a basis for causal reasoning. It would also be expected that the play materials provided for a child would influence his sensori-motor development.

Following the sensori-motor stage, the child moves into the preoperational stage (Furth, 1970; Ginsburg, and Opper, 1969). It is during this stage that the child comes to know things apart from his actions upon them. This stage is heralded by the development of representation which is the ability of the child to represent mentally objects and actions which are not perceptually present. Also, during this stage the beginnings of the development of the symbolic function can be observed in the child's language as well as in symbolic play and imitation. The formation of several schemes begins during this stage; specifically, the child's scheme of classification, his scheme of ordering, and his scheme of number all appear. The child's schemes at this age, however, are more dependent on personal experience than are those of the older child. Piaget calls this characteristic egocentrism.

Language begins to play a greater role in the child's development after he leaves the sensori-motor stage, but the structures characteristic of the preoperational stage are not highly dependent on language input to the child. Language may give the child insight into an adult's

method of reasoning (Ginsburg & Opper, 1969) and it may provide the child with content upon which his schemes operate (Best, 1972). Thus, a deaf child's development might be expected to show more differences from the hearing child's at the preoperational and later stages of cognitive development than would be expected at the sensori-motor stage.

Cognitive Development in Deaf Children

Previous studies of the cognitive development of older deaf children have led to varied results. Some investigations, (Oléron & Herron, 1961; Furth, 1966; Best, 1972) have found deficits in the cognitive development of deaf children, while others have found little or no retardation (Furth, 1964; Borelli, 1951; Best, 1972). These discrepancies result from several factors: difference in the nature of the tasks; difference in methods of presentation of the tasks; and differences in the subjects themselves. However, there has been no research on the early cognitive development of deaf children, the group for whom much of the work on curriculum is currently being done.

It is the contention of some researchers currently that the delay seen in the cognitive development of deaf children is a result of inappropriate environmental stimulation rather than to a deficit in oral language (Furth, 1973; Tomlinson-Keasey & Kelly, 1974). Furth (1973) believes that given a challenging and flexible environment suited to the special needs of a hearing impaired child, that child's thinking skills will progress at a normal rate through the normal stages as outlined by Piaget. Tomlinson-Keasey and Kelly (1974)

postulate that hearing impaired children would progress adequately through sensori-motor and concrete operational stages, but could be expected to show a deficit in dealing with abstractions unless curricula can be constructed in order to help them develop their ability. Curriculum materials based on a Piagetian model of cognitive development are currently in use and being developed for special education purposes (Wolff, 1969; Hawkins, 1969). In order for these curriculum materials to be successful, research is necessary on the cognitive needs of the children as well as on their most successful modes for learning. Furthermore, research on the early cognitive development of deaf children can provide necessary guidelines for the development of intervention programs involving parents in the education of their child.

Environmental Processes

It is generally taken for granted that a child's home environment is influential in his later cognitive development. Recent research has explored a variety of factors involved in this question. Several investigators have now produced evidence that measures of various process variables of the environment including characteristics of the home environment contribute more strongly to the prediction of children's abilities than do social status or family structure indices (Caldwell & Richmond, 1967; Jones, 1972; Walberg & Marjoribanks, 1973).

Wachs, Uzgiris and Hunt (1971) found relationships between certain process variables and specific aspects of sensori-motor development. Specifically, they found that high levels of noise, sound, and general

activity in the home were negatively correlated with several aspects of sensori-motor development while verbal stimulation of infants by their parents was positively related to sensori-motor development.

Elardo, Bradley and Caldwell (1975) investigated the relationship between the home environment of infants and their performance on mental tests between the ages of six to 36 months. They found that certain aspects of the home environment were significantly correlated with later mental development. Specifically, organization of the environment and opportunities for variety in daily routine were most highly correlated with mental test performance during the first year of life. After the age of one year, however, provision of appropriate play materials and maternal involvement with the child became the most salient factors. They conclude that the most enriching environment for the child one year of age or older is one in which the mother provides learning materials appropriate to the child's developmental level[1] and consciously promotes the child's developmental progress.

Information about the effects of early environmental stimulation on cognitive development is particularly important in the case of deaf children who, by definition, receive, or are exposed to, a different type of environmental stimulation. Specifically, the nature of the communication between the child and others in his environment is likely to be very different for the deaf child.

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[1] It should be noted, given the research with deaf children, that these materials may be different for deaf and hearing children. They may also need to be selected with awareness of the child's sensory handicap.

Two recent studies have focused on the nature of the mother-child interaction for preschool deaf children (Schlesinger & Meadow, 1972; Goss, 1970). Both studies report differences in interaction patterns between mothers of deaf and mothers of hearing children. However, these studies have focused primarily on the social-emotional components of the interaction and not on the ways in which information is given and received in mother-child interaction and the relationship of the interaction patterns to cognitive functioning in the child. Several studies (e.g., Hess & Shipman, 1965; Bee, et al., 1969; Streissguth & Bee, 1972) have investigated the relationships between mother-child interaction patterns and cognitive development in hearing children. In general, it has been found that some of the patterns of maternal behaviors, especially those involving positive rather than negative feedback and the use of questions rather than statements in teaching, were positively related to performance on cognitive tasks. It could be expected that maternal-child interaction patterns affect the cognitive development of young deaf children as well.

METHODOLOGY

Subjects

The subjects in this study were 16 children between the ages of 23 and 38 months at the time of initial testing (Time 1). All of the subjects were enrolled in preschool programs for the hearing impaired and were screened with the Denver Developmental Screening Test (to eliminate children with secondary handicaps). Eleven of the children

were followed over a two-year period and were between the ages of 36 and 54 months at the time of the second testing (Time 2.)[2] The number of boys and girls tested is shown below:

	Age Range	Total Number	Boys	Girls
Time 1	23-38 mo.	16	10	6
Time 2	36-54 mo.	11	7	4

The probable etiology of the hearing impairment was hereditary for six subjects, flu, rebella or infection suspected for four subjects and unknown for six subjects. The degree of hearing loss ranged from 65 to 110 db. across the speech range in the better ear. The mean hearing loss for the group across the speech range in the better ear was 97.0 db.

Efforts were made to locate as many deaf children in the Minneapolis/St. Paul Metropolitan area as soon after diagnosis as possible in order to include them in the study. Because the incidence of hearing impairment is low when rubella is under control, the sample was small. Control groups of children with normal hearing matched on age were established after the age range of the hearing impaired subjects was determined. The control subjects were used for those tasks for which standardization data were not avaiable.

Measures

Time 1. Two measures were selected for use at the time of first testing: the Infant Psychological Development Scale (Uzgiris & Hunt,

[2] Of the five children who were not included in the second year of testing, 2 were no longer available to the study (in one case because the family had moved and in the other becauce of lack of cooperation) and 3 were too young for the battery of measures.

1966) and the HOME Inventory (Caldwell, 1966). The IPDS, which was developed as a research instrument based on Piagetian theory, was used to measure sensori-motor development. This scale has been widely used and was easily adapted for use with young deaf children since it requires little or no language in the administration. The subscales of the IPDS include: 1) object permanence, 2) objects as means, 3) schemas, 4) causality, 5) objects in space, 6) vocal imitation, and 7) motor imitation. The HOME Inventory (birth to three), a standardized research scale, was used to measure early environmental stimulation provided in the home. The inventory contains 45 items representing the following six subscales: 1) emotional and verbal responsivity of the mother, 2) avoidance of restriction and punishment, 3) organization of the physical and temporal environment, 4) provision of appropriate play materials, 5) maternal involvement with the child, and 6) opportunities for variety in daily routine. Scoring is based partly on observation and partly on answers to interview questions. The Inventory is administered in the home when the child is awake and can be observed in interaction with the mother, or primary care giner.

Time 2. The four measures that were used when the subjects were 36 to 54 months old were the HOME Inventory (ages 3 to 6), the Utah Test of Language Development, and two measures which were developed by the project, namely, a structured mother-child interaction task and a classification task.

The HOME Inventory was an extension of the inventory used for subjects at Time 1. At the 3-6 age level the scales included:

1) provision of stimulation through equipment, toys and experiences; 2) stimulation of mature behavior; 3) provision of stimulating, physical and language environment; 4) avoidance of restriction and punishment; 5) pride, affection and thoughtfulness; 6) masculine stimulation; 7) large muscle activities; and 8) independence from parental control. Eighty items are included and the format again is one including both interview and observation.

The Utah Test of Language Development consists of 51 items across the age range of 1.5 to 14.5 years and measures both expressive and receptive language skills. The majority of the items are designed for preschool-age children. It is primarily a measure of maturity of language usage and provides a language age score. Items included in the test have been chosen from other standardized measures and thus have good face validity. The Utah was chosen for this study because it is the best instrument currently available for measuring language usage skills of preschool children.

For the mother-child interaction task the child was presented with a model house built of 22 blocks of various shapes and colors and was requested to construct a house that was the same. The mother was instructed that she could help the child as much or as little as she wanted. No time limit was imposed. All mother-child interactions during the task were videotaped and subsequently transcribed and scored. The mother's language and behavior was scored on a three-dimensional scale, consisting of content, affect and specificity. The content dimension is concerned with the type of information the

mother communicates to the child, while affect refers to the emotional aspects of that information and specificity covers the generality or preciseness of the information. The child's behavior was scored for compliance versus noncompliance and dependence versus independence.[3] Interpair reliability in the scoring was established at .70 for content, .80 for affect, .65 for specificity.

The classification task was designed to observe the child's ability to classify picture cards into similar groups. Items ranged from classification of identical elements (e.g., two identical butterflies) to the hierarchical classification of two subordinate elements within a superordinate class (e.g., a pig and a horse as a subclass of domestic animals within the superordinate class of all animals). The task involved a forced choice on the part of the child rather than a free sorting response. This approach was chosen to minimize confusion over instructions. All children were trained on training items before beginning the test itself and three check items were inserted to assure that the children's failures were a result of inability to do the task rather than a misunderstanding of instructions. The task was intended to measure the child's ability to classify pictorial materials based on verbal concepts rather than perceptual differences.[4]

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[3] See Appendix A for definitions and illustrations of the mother-child interaction scoring system.

[4] See Appendix B for specific items used.

Procedures

All testing of each hearing impaired child was done in the child's home with the mother present. The tasks were administered either orally or by use of total communication depending on the mode of communication used in the home.

At Time 1 (subjects 23 to 38 months old), each experimental subject was seen for two sessions. During the first session relevant background information was obtained from the mother and the IPDS was administered. During the second session the Denver Developmental Screening Test was given and interview and observation procedures were completed for the HOME Inventory. Control subjects were seen only once for the administration of the IPDS.

At Time 2 (subjects 36 to 54 months old), the hearing impaired subjects were seen for two additional sessions. The version of the HOME Inventory for ages 3 to 6 was administered as well as the Utah Test of Language Development during the first of these sessions. The mother-child interaction task and the classification task were given during the second session. The control subjects were seen only once at which time the mother-child interaction and the classification tasks were administered.

RESULTS

Time 1

The issues under investigation at Time 1, when the subjects were 23 to 38 months, involved the nature of the sensori-motor development, the nature of the home environment of young deaf children and

the relationship between the two. The results of the testing on the IPDS are shown in Table 1. The significance of differences between the deaf and the hearing subjects was determined by t tests. It was found that the deaf subjects performed as well as the hearing subjects on all of the subscales except vocal imitation. The difference between the groups on vocal imitation ($t = 2.92$) was significant at the .01 level. However, the performance of the deaf subjects on the IPDS as a whole ($t = 1.59$) was not significantly different than that of the hearing children.

Table 2 gives the results of the HOME Inventory at Time 1. A chi square goodness of fit test was used to compare the results of the observation/interview with mothers of deaf children to the normative data available for the scale. Mothers of the deaf children provided, overall, more positive environmental stimulation for their children than did mothers in the normative group ($X^2(1) = 11.4$; $p < .01$), organization of the environment ($X^2(1) = 9.9$; $p < .01$), provision of appropriate play materials ($X^2(1) = 9.9$; $p < .01$), and opportunity for variety in daily routine ($X^2(1) = 21.1$; $p < .01$), as well as the total score. Mothers of young deaf children, however, were neither more permissive nor more punitive than were mothers of the children of the normative sample. They also exhibited an equal amount of maternal involvement when compared with the norm group.

Scores on subscales of the IDPS were correlated with scores on the HOME Inventory as shown in Table 3. There are several significant correlations in two areas. First, the child's understanding of

Table 1

Mean Scores on the Infant Psychological Development Scale by Deaf and Hearing Children

Subscale	Deaf (n=16) Mean	SD	Hearing (n=16) Mean	SD	t value
Object permanence	12.75	2.46	13.38	1.36	-.89
Objects as means	7.19	1.80	7.56	1.09	-.71
Schemas	2.18	.91	2.62	1.50	.43
Causality	1.94	1.12	2.25	1.00	-.83
Objects in space	5.31	.70	4.88	1.20	1.25
Vocal imitation	2.06	2.24	4.31	2.12	-2.92**
Motor imitation	2.31	1.01	2.62	.62	-1.05
Total	34.38	5.80	37.56	5.52	-1.59

* $p < .05$

** $p < .01$

Table 2

Mean Scores on the HOME Inventory

by Parents of Deaf and Normative Groups

Subscale	Deaf[a] Mean	Deaf[a] SD	Normative Group Mean	Normative Group SD
Emotional and verbal responsivity of mother	9.2	1.9	7.8	2.3
Avoidance of restriction and punishment	5.8	1.6	5.5	1.5
Organization of environment	5.6	0.5	4.8	1.2
Provision of appropriate play materials	7.8	0.9	6.1	2.5
Maternal involvement with child	4.3	1.2	3.4	1.7
Opportunity for variety in daily routine	4.5	0.8	2.8	1.3
Total	37.2	4.7	30.4	7.7

[a] $n = 16$

causality was positively correlated with the emotional and verbal responsivity of the mother, the organization of the home environment, and the total score on the HOME Inventory. Secondly, the child's development of motor imitation was significantly negatively correlated with the organization of the home environment, the provision of appropriate play materials and the total score. Thus, the understanding of causality and motor imitation are most highly correlated with the home environment of the child as measured by the HOME Inventory.

Time 2

The areas under investigation at Time 2, when the subjects were 36 to 54 months, included the communication between mother and child during the structured mother-child interaction task, performance on the classification task and relationships between the two. The Utah Test of Language Development and the HOME Inventory (ages 3 to 6) also were given.

Preliminary analysis of data from the Mother-Child Interaction (MCI) task using contingency tables and X^2 tests (see Table 4) indicated significant differences between the mothers of deaf and hearing subjects on the content categories ($X^2(5) = 61.18$; $p < .01$), and affect categories ($X^2(2) = .65$; $p < .75$). There were also significant differences between the deaf and hearing children on the categories of child behavior ($X^2(3) = 20.52$; $p < .001$).

Raw scores were converted to percentages and then transformed using the arc sin transformation in order to allow comparisons of individual categories (see Table 5). For the content categories,

Table 3

Pearson Product-Moment Correlations between the Home Inventory and IPDS for Deaf Children[a]

HOME Subscales	IPDS Subscales							
	Object Permanence	Object Means	Schemas	Causality	Object Space	Vocal Imitation	Motor Imitation	IPDS Total
Emotional responsivity	0	.18	.18	.51*	.39	.23	-.43	.25
Avoid restriction & punishment	-.17	-.03	-.31	.14	-.06	-.15	-.09	-.18
Organization environment	.30	.23	-.16	.67**	.16	-.16	-.54*	.17
Play materials	-.12	-.21	.17	.43	-.08	.01	-.55*	-.10
Maternal involvement	.05	-.12	.42	.36	.03	.39	-.47	.19
Opportunities for variety	-.26	-.39	.04	.03	-.40	-.27	-.04	-.38
HOME Total	-.08	-.05	.10	.51*	.08	.08	-.50*	.02

[a] $n = 16$

* $p < .05$

** $p < .005$

Table 4

Frequencies and Chi-Square Values by Category on Mother-Child Interaction Task between Deaf and Hearing Children

Category	Deaf (n=11)	Hearing (n=11)	
Content			
Directive	142	85	
Declarative Suggestion	76	65	
Question Suggestion	30	55	
Feedback Response	186	189	
Attention Response	70	10	
Orienting Response	154	184	
			$X^2(5) = 61.18^{**}$
Affect			
Positive	84	92	
Neutral	513	484	
Negative	60	11	
			$X^2(2) = 31.19^{**}$
Specificity			
One	206	177	
Two	250	236	
Three	203	174	
			$X^2(2) = .65$
Child Behavior			
Compliance	200	214	
Noncompliance	51	37	
Dependence	101	45	
Independence	137	134	
			$X^2(3) = 20.52^{**}$

** $p < .01$

mothers of deaf children used significantly more attention getting responses ($t = 5.73$; $p < .001$) but fewer orienting responses ($t = -2.25$; $p < .04$) than the mothers of hearing children. There was also a tendency for mothers of deaf children to use more directive strategies, though this difference was not significant. For affect categories, it was found that mothers of young deaf children were more likely to express negative affect with their child ($t = 3.19$, $p < .01$) but no less likely to use positive affect than the mothers of hearing children ($t = -1.23$, n.s.). There were no significant differences on the level of specificity categories for the two groups. There was a tendency for the young deaf children to be less compliant and more dependent than were the hearing children when interacting with their mothers on their task. Again this difference was not significant.

The mean score on the classification task for the deaf children was 13.3 ($SD = 13.52$) and for the hearing children was 22.0 ($SD = 6.81$). Although the difference did not reach significance, the young deaf children are beginning to show a delay in their development compared to controls on the classification task ($t = -1.91$; $p < .07$). The range of performance on the classification task was much greater for the deaf subjects than for the hearing controls, as is reflected in the respective standard deviations.

An indication of the language abilities of the deaf subjects is given by comparing their language age ($\bar{X} = 39.6$ months) as measured by the Utah to their chronological age ($\bar{X} = 43.7$ months). Thus, the language development of the hearing impaired subjects was somewhat below their chronological age level.

Table 5

Mean Scores on Mother-Child Interaction Task for Deaf and Hearing Children (Arc Sin Transformation)

Category Category	Deaf (n=11) Mean	Deaf (n=11) SD	Hearing (n=11) Mean	Hearing (n=11) SD	t-value
Content					
Directive	.94	.20	.77	.22	1.85
Declarative Suggestion	.67	.18	.67	.18	.01
Question Suggestion	.42	.11	.48	.36	-.57
Feedback Response	1.12	.13	1.22	.16	-1.50
Attention Response	.66	.12	.20	.18	5.73**
Orienting Response	.99	.23	1.18	.16	-2.25*
Affect					
Positive	.70	.20	.81	.23	-1.23
Neutral	2.17	.13	2.28	.25	-1.30
Negative	.54	.32	.16	.24	3.19**
Specificity					
One	1.21	.27	1.18	.18	.33
Two	1.30	.14	1.34	.23	-.53
Three	1.15	.22	1.15	.20	.02
Child Behavior					
Compliance	1.40	.29	1.63	.36	-1.67
Noncompliance	.65	.19	.52	.24	1.40
Dependency	.86	.39	.60	.27	1.82
Independence	1.07	.27	1.11	.37	-.31

* $p < .05$

** $p < .01$

It was not possible to compare the results of the HOME Inventory for the parents of the deaf children to the standardized norms for the Inventory as they are not as yet available from the developers of the instrument. However, mean scores and the total possible score on each subscale are given in Table 6. In general, the parents are providing a high level of environmental stimulation as measured by the HOME.

Patterns of correlations between the environmental measures (HOME and MCI) and the cognitive measures (Classification and Utah) are also of interest (See Table 7). There were no significant positive correlations between the environmental and classification measures for the hearing impaired subjects. The highest positive correlations were between classification and stimulation of mature behavior, orienting responses on the part of the mother, and noncompliance on the part of the child. The highest negative correlations were between classification and the pride, affection and thoughtfulness and provision of large muscle toys scales on the HOME, and declarative suggestions on the MCI task. For the hearing controls there were some significant correlations between the classification task and maternal responses and child responses on the MCI (see Table 8). The child's performance on the classification task was significantly positively correlated with the mother's feedback responses, and a low level of specificity in the mother's responses overall. It was significantly negatively correlated with the child's dependent responses on the MCI.

Because the classification measure was in part a measure of the child's learning of verbal concepts as well as cognitive structures,

Table 6

Mean Scores on HOME Inventory (Ages 3 to 6)

for Deaf Subjects and Total Possible Scores

Subscale	Deaf Subjects[a] Mean	Total Possible Score
Provision of stimulation through toys, experiences	17.7	21
Stimulation of mature behavior	9.0	12
Provision of stimulating physical and language environment	11.5	12
Avoidance of restriction and punishment	6.4	7
Pride, affection and thoughtfulness	11.9	16
Masculine stimulation	1.6	2
Large muscle activities	2.9	3
Independence from parental control	6.0	7
Total	67.1	80

[a] $n = 11$

Table 7

Pearson Product-Moment Correlations between Environmental and Cognitive Measures and Hearing Loss for Deaf Children[a]

Measure	Classification	Utah	Hearing Loss
HOME			
Toys experiences	-.15	.03	-.33
Mature behavior	.40	.34	-.39
Play & language environment	.21	.17	-.30
Avoid restriction & punishment	.14	-.61*	.30
Pride, affection, thoughtfulness	-.61*	-.36	-.29
Masculine Stimulation	-.17	-.07	.13
Large Muscle	-.40	-.53	.02
Independence	-.12	.18	-.19
Total	-.24	-.15	-.32
Mother & Child Interacting			
Content			
Directive	-.07	-.28	-.50
Declarative Suggestion	-.40	-.43	-.12
Question Suggestion	-.18	.39	.11
Feedback Response	.04	-.11	-.45
Attention Response	.12	.06	.31
Orienting Response	.41	.60*	.74**
Affect			
Positive	-.22	.02	-.27
Neutral	-.01	-.22	.24
Negative	.32	.21	.28
Specificity			
One	.03	-.21	.38
Two	-.07	.47	.04
Three	-.01	-.08	-.50
Child Behavior			
Compliance	-.21	-.42	-.25
Noncompliance	.44	.63*	.08
Dependency	.21	.18	-.33
Independence	-.13	.17	.64*

[a] $n = 11$

* $p < .05$
** $p < .01$

Table 8

Pearson Product-Moment Correlations between Mother-Child Interaction Categories and Classification for Hearing Children[a]

Category	Classification
Content	
Directive	-.16
Declarative Suggestion	.31
Question Suggestion	-.39
Feedback Response	.56*
Attention Response	-.12
Orienting Response	-.33
Affect	
Positive	.46
Neutral	-.49
Negative	.45
Specificity	
One	.73**
Two	-.70**
Three	.17
Child Behavior	
Compliance	.24
Noncompliance	-.19
Dependency	-.64*
Independence	-.03

[a] $N = 11$

* $p < .05$
** $p < .01$

a correlation of .65 ($p < .05$) between the classification task and the Utah was of interest.

Since it could be expected that language development might be related to the verbal input of the environment, scores on the classification measure were correlated with hearing loss. These correlations were low, positive and nonsignificant. The correlation coefficient for classification and hearing loss was .12 and for the Utah and hearing loss was .15.

Both the classification measure and the Utah were significantly positively correlated with age: $r = .83$ ($p < .01$) and $r = .61$ ($p < .05$) respectively.

Comparisons between Time 1 and Time 2

The relationships between the IPDS and HOME measures of Time 1 and the MCI, and classification and Utah measures of Time 2 were examined for the hearing impaired subjects.

The subscales of the IPDS that showed the highest correlation with the MCI variables were causality, vocal imitation, motor imitation, and the IPDS total. The understanding of causality and vocal imitation were positively correlated with high specificity as was the IPDS total (See Table 9). Performances on the motor imitation scale was negatively correlated with high specificity on the mother-child interaction task.

Correlations between environmental measures at Time 1 (HOME Inventory) and cognitive measures at Time 2 (Classification & Utah) can be seen in Table 10. The only significant positive correlation was between the measure of maternal involvement on the HOME and the Utah Test of Language Development. Maternal involvement was also the subscale most highly correlated with the measure of classificatory

Table 9

Pearson Product-Moment Correlations Between IPDS and Mother-Child Interaction Categories for Deaf Children[a]

MCI Categories	IPDS Subscales							
	Object Perm.	Object Means	Schemas	Caus-ality	Object Space	Vocal Imit.	Motor Imit.	IPDS TOTAL
Content								
Directive	.43	.16	.33	.52	-.19	.46	-.47	.41
Declarative Suggestion	.08	-.09	-.29	-.24	.32	-.38	.07	-.26
Question Suggestion	-.31	-.31	.40	-.48	-.13	.13	.19	-.03
Feedback Response	-.64*	-.09	.04	-.30	.23	-.12	.25	-.17
Attention Response	-.01	.51	-.36	.44	.38	-.05	.23	.23
Orienting Response	.17	-.41	.02	-.35	-.63*	-.11	-.11	-.33
Affect								
Positive	.40	-.35	.14	.08	.56	.24	-.61	.12
Neutral	-.07	-.28	-.30	-.73*	-.62*	-.65*	.33	-.69*
Negative	-.33	.50	.06	.35	-.15	.19	.27	.29
Specificity								
One	-.31	.06	-.51	-.70*	-.47	-.77**	.71*	-.64*
Two	.11	-.17	.35	.58	.30	.62*	-.49	.46
Three	.38	.14	.41	.65*	.54	.62*	-.63*	.62*
Child Behavior								
Compliance	-.14	-.25	-.01	.05	.27	.07	-.24	-.06
Noncompliance	.45	-.13	.26	.74*	.13	.52	-.44	.53
Dependency	-.25	.57	.28	-.05	-.02	.10	.32	.28
Independence	.53	-.39	-.22	-.28	-.39	-.21	-.04	-.29

[a] $n = 10$

*$p < .05$

**$p < .01$

Table 10

Correlations Between HOME Subscales and

Time 2 Measures of Cognitive Development for Deaf Children[a]

HOME	Classification	Utah	Hearing Loss
Emotional responsivity	-.15	-.00	-.01
Avoid restriction & punishment	-.37	-.21	-.28
Organization environment	.18	.14	.15
Play materials	.26	-.45	-.47
Maternal involvement	.44	.68*	-.68*
Opportunities for variety	.25	.02	-.34
Total	.12	.27	-.50

[a] $n = 11$

* $p < .05$

development, but this relationship was not significant. The maternal involvement scale was significantly negatively correlated with hearing loss. Also, the provision of appropriate play materials subscale was correlated with later language development as measured by the Utah, but this was not significant.

Correlations between the measure of cognitive development at Time 1, the IPDS, and measures of cognitive development at Time 2 can be seen in Table 11. The schemas subscale was significantly correlated with the Utah ($r = .59$, $p < .05$) and with hearing loss ($r = -.66$, $p < .05$). Schemas was also positively correlated with the development of classification abilities. Other scales of the IPDS which were positively correlated with the Utah, though not significantly, included causality, vocal imitation and total score. Motor imitation was negatively correlated with the Utah Test of Language Development.

DISCUSSION

Differences between the deaf children and the hearing controls on the Infant Psychological Development Scale were minimal, with only one reaching statistical significance. Thus, these young deaf children are progressing quite normally through the sensori-motor stage of cognitive development. These results support Piaget's contention that sensori-motor development is primarily dependent on the child's active interaction with the environment.

As stated above, only one area showed a significant difference between deaf and hearing children--vocal imitation. This is also the

Table 11

Correlations Between IPDS Subscales and

Time 2 Measures of Cognitive Development for Deaf Subjects[a]

IPDS	Classification	Utah	Hearing Loss
Object permanence	-.06	.22	.46
Objects as means	.09	-.05	-.14
Schemas	.31	.59*	-.66*
Causality	.17	.42	-.38
Objects in space	-.01	.32	-.18
Vocal imitation	.26	.49	-.49
Motor imitation	-.29	-.53	.15
Total	.20	.48	-.50

[a] $n = 11$

* $p < .05$

area which is obviously most influenced by aural input. However, these results suggest that in later years other areas which depend directly on aural input will also show delay. Second year data on the children shows that in terms of later classificatory development they are beginning to show a delay when compared to hearing children on verbal concepts, and tend to classify at a lower level than hearing children of the same age.

The results of the HOME Inventory (birth to 3) also have positive implications for the development of deaf children. On all measures of environmental stimulation at Time 1 except two, the mothers of the hearing impaired subjects were providing higher levels of stimulation than were the mothers in the normative group.

Two areas of sensori-motor development--causality and motor imitation--were most highly correlated with home environment. The correlation between the development of causality and the organization or predictability of the environment is the most theoretically and rationally logical. The consistently negative correlations of motor imitation with all aspects of the home environment suggest that there is some underlying factor involved which was not measured and is not readily apparent.

By 36 to 54 months more significant differences begin to emerge between young deaf children and hearing controls. In the mother-child interaction task, mothers of young deaf children used more attention getting responses but fewer orienting responses than the mothers of hearing children. It was necessary for the mothers of the deaf

children to first get the child's attention and then direct it to the task. Thus, the communication of information about the task required sequential attention on the part of the hearing impaired child rather than simultaneous attention as was possible for the child with normal hearing. Also, it was seen that attention responses are not highly correlated with either classificatory development or language development. Thus, mothers of deaf children may in a sense be wasting their interaction time with their children by using high numbers of attention responses rather than some more constructive type of response.

The mothers of the deaf children also expressed significantly more negative affect with their child in the task. The negative affect usually came as a frustration response on the part of the mothers of hearing impaired children later in the task. The child in turn tended to be less compliant and to make more dependency bids. One can speculate that the difficulties in communicating information to the child give rise to more negative affect on the part of the mother which in turn has negative consequences as reflected in the child's behavior.

The level of specificity categories would seem to have different meaning for the deaf and hearing subjects. A low level of specificity is positively correlated with scores on the classification for hearing subjects. This result is consistent with the relationship reported by Streissguth and Bee (1972) where it was postulated that low specificity allowed the child to discover relationships on his own. However, no

consistent pattern emerged for the deaf subjects. High specificity was positively correlated with the use of directives by the mother and compliance by the child. These results suggest that mothers do use different communication patterns with deaf and hearing children and that the patterns used by mothers of deaf children may not be as effective in communicating necessary information about the environment.

A slight developmental lag was seen when comparing deaf to hearing subjects on the classification task. This may be interpreted to reflect a lag in verbal concept development rather than in cognitive structure. The deaf subjects language age on the Utah was also lower than would have been expected given their chronological age.

Few significant correlations existed between environmental measures ($HOME_2$ and MCI) and measures of classificatory and language development (Classification and Utah). It may be that the environmental variables measured in this study are less influential in the development of verbal abilities than in the development of underlying cognitive structures.

In looking at the relationship between the measures at Time 1 and those at Time 2, the development of causality subscale of the IPDS again seems to be a very critical indicator for the young deaf subjects. The development of causality was positively correlated with the level of specificity the mother used. The level of specificity variable would appear to be important in terms of the nature of the information the mother communicates to her hearing impaired child. Perhaps further study could reveal linguistic and non-linguistic aspects of the level

of specificity that a mother uses in communicating with her young deaf child. Correlations between the mother-child interaction task and the IPDS suggest the interactional nature of the process in that the child's level of cognitive functioning influences maternal behavior and maternal behavior influences the child's further development.

In agreement with the study by Elardo, Bradley & Caldwell (1975), maternal involvement and provision of appropriate play materials scales on the HOME in the early years of the child's life show the strongest relationship with later mental development. Also, it was seen that the early measures of verbal development (schemas and vocal imitation on the IPDS) were correlated most highly with the later measures of classificatory and language development (Classification and Utah).

CONCLUSIONS

It was seen in this study that the early cognitive development of deaf children through what Piaget terms the sensori-motor stage proceeds quite normally. Cognitive structures dependent on active interaction with the environment develop along similar lines in deaf and hearing children. However, cognitive development which is more clearly dependent on verbal interaction with the environment or what Piaget terms social transmission does show a discrepancy when deaf children are compared to hearing children as on the classification task. This suggests that early intervention programs with deaf children need to focus more strongly in this area, improving communication abilties

and developing curriculum materials which better teach those concepts which are usually transmitted through social interaction with the environment. The results of the HOME Inventory (Time 1) suggest that parents of young deaf children can provide stimulating environments for their children. Most of the deaf children in the study were also enrolled in local preschool programs for the hearing impaired which included parental components. Thus, the high level of home stimulation can be a result of preschool programming or perhaps mothers of young deaf cildren naturally provide a more stimulating environment in order to compensate for their child's sensory handicap. We would encourage the use of parental components in program planning.

The observed differences in the nature of the mother-child interactions for deaf and hearing children should also be taken into account when planning preschool programs. Ways of helping mothers of hearing impaired children develop communication skills for transmitting relevant information to their children should be explored. If early cognitive development of the child affects the nature of the maternal interaction with the child then we must begin assistance early to insure that the reciprocal effects of child and maternal behavior will be positive.

References

Bee, Helen F., Van Egeren, L. F., Streissguth, A. P., Nyman, B. A., and Leckie, M. S. Social class differences in material teaching strategies and speech patterns. Developmental Psychology, 1969, 1, 726-634.

Best, B. Development of classification skills in deaf children with and without early manual communication. Unpublished doctoral dissertation, University of California, Berkeley, 1972.

Borelli, M. La naissance des operations loquque chez le sourd-muet. Enfrance, 1951, 4, 222-238. Cited by Furth, 1964.

Caldwell, B., Heider, J. and Kaplan, B. The inventory of home stimulation. Paper presented at the American Psychological Association, New York, 1966.

Caldwell, B. and Richmond, J. Social class level and stimulation potential of the home. In Hellmuth (Ed.), Exceptional Infant, Vol. 1, 1967.

Dave, R. H. The identification and measurement of environmental process variables that are related to educational achievement. Unpublished doctoral dissertation, University of Chicago, 1963.

Elardo, R., Bradley, R., and Caldwell, B. The relation of infants' home environments of mental test performance from six to thirty-six months: A longitudinal analysis. Child Development, 1975, 46, 71-76.

Furth, H. G. Conservation of weight in deaf and hearing children. Child Development, 1964, 35, 143-150.

Furth, H. G. Thinking Without Language. New Jersey: Prentice-Hall, Inc., 1966.

Furth, H. G. Piaget for Teachers. New Jersey: Prentice-Hall, Inc., 1970.

Furth, H. G. Deafness and Learning: A psychosocial approach. California: Wadsworth, 1973.

Ginsburg, H. and Opper, S. Piaget's Theory of Intellectual Development. New Jersey: Prentice-Hall, Inc., 1969.

Goss, R. N. Language used by Mothers of Deaf Children and Mothers of Hearing Children. American Annals of the Deaf, 1970, 115, 93-96.

Hawkins, F. The logic of action: From a teacher's notebook. Boulder: University of Colorado Press, 1969.

Hess, R. D. and Shipman, V. C. Early experience and the socialization of cognitive modes of children. Child Development, 1965, 36, 869-886.

Jones, P. Home environment and the development of verbal ability. Child Development, 1972, 43, 1081-1086.

Oleron, P. and Herren, H. L'acquisition des conservations et le language: Etude comparative sur des enfants sourds et entendants. Enfance, 1961, 14, 203-219. Cited by Furth, 1964.

Piaget, J. and Inhelder, B. Psychology of the child. New York: Basic Books, 1969.

Roberts, G. C. and Black, K. N. The effect of naming and object permanence on toy preferences. Child Development, 1972, 43, 858-868.

Schlesinger, H. S. and Meadow, K. P. Sound and Sign: Childhood Deafness and Mental Health. Berkeley: University of California Press, 1972, (Chap. 5).

Schmidt, W. & Hare, T. Some nonverbal aspects of communication between mother and preschool child. Child Development, 1970, 41, 889-896.

Sinclair, H. Developmental psycholinguistics. In D. Elkind and J. Flavell (Eds.), Studies in Cognitive Development. London: Oxford University Press, 1969.

Sinclair, H. Sensori-motor action patterns as a condition for the acquisition of syntax. In R. Hyxley and E. Ingram (Eds.), Language acquisition: Models and methods. London: Academic Press, 1971.

Streissguth, A. and Bee, H. Mother-child interactions and cognitive development in children. In W. Hartup (ed.), The Young Child: Reviews of Research. Washington, D. C.: NAEYC, 1972.

Suppes, Patrick. A survey of cognition in the handicapped child. Institute for Mathematical Studies in the Social Sciences, Technical Report No. 197, Stanford University, Palo Alto, California, 1972.

Tomilson-Keasey, C. and Kelly, R. The development of thought processes in deaf children, American Annals of the Deaf, 1974, 119, 693-700.

Uzgiris, Ina, C. Patterns of Cognitive Development in Infancy, Merrill-Palmer Quarterly, 1973, 19, 181-204.

Uzgiris, I. and Hunt, J. McV. An instrument for assessing infant psychological development. Mimeographed paper, University of Illinois, 1966.

Wachs, T. D., Uzgiris, I. C., Hunt, J. McV. Cognitive development in infants of different age levels and from different environmental backgrounds. Merrill-Palmer Quarterly, 1971, 17, 283-317.

Walberg, H. & Marjoribanks, K. Differential mental abilities and home environment: A canonical analysis. Developmental Psychology, 1973, 9, 363-368.

Wolff, S. A process report on a thinking laboratory for deaf children. Paper presented at the 44th Meeting of the Convention of American Instructors of the Deaf, Berkeley, California, 1969.

Appendix A

Mother-Child Interaction Scoring System

SCORING DIRECTIONS

The mother's verbalizations and actions will be scored on a three-dimensional scale, consisting of content, affect and specificity. The content dimension is concerned with the type of information the mother communicates to the child, while affect refers to the emotive aspects of that information and specificity covers the generality or conciseness of the information. Consequently, each of the mother's events will receive three ratings - one in each of the above dimensions. The dimensions are defined and illustrated on the following pages. The child's behavior will be scored on either of two polar scales. These are compliance-noncompliance and dependence-independence. Definitions are on the following pages.

SPECIAL DIRECTIONS

It is important that the scorer keep the following in mind:

1. Not all interrogatives are question suggestions.
2. Not all directives are of negative affect.
3. Feedback about the incorrectness of a child's action need not be negative.

MOTHER-CHILD INTERACTION SCORING PROCEDURE

PART I. Mother's Verbalizations and Actions

CONTENT

Directive: Mother DEMANDS some behavior or action of the child. An order or direction.
Examples:
1. "come on now"
2. [mother grabs child's arms]
3. "put the roof on"
4. [mother guides child's hand to a particular block]
5. "find a red one"

Declarative Suggestion: Mother suggests some SPECIFIC procedure or provides some SPECIFIC information to the child in the form of a declarative statement.
Examples:
1. "you need more blue blocks"
2. "the long ones go on top"
3. [Mother holds up blue block with red on top. (correct)]
4. "there are blue blocks all around the bottom"
5. [mother offers child a block]

Question suggestion: Mother suggests some SPECIFIC procedure or provides some SPECIFIC information to the child in the interrogative form.
Examples:
1. "do you need more blue blocks?"
2. "do the long ones go on top?"
3. [mother holds up red block with blue on top (incorrect)]
4. "are there red blocks on the bottom?"
5. [mother holds two blocks out to child] (expecting child to choose one)
6. "shall we build the bottom first?"

Feedback Response: Mother makes a statement, asks a question or engages in an activity that apprises the child of his or her progress or correctness of actions.
Examples:
1. "well, it looks like you're doing it O.K."
2. "that doesn't look the same, does it?"
3. [child makes a dependency bid.] Mother says "No" (that is wrong)
4. [mother ignores child's dependency bid]
5. [Mother smiles and nods.]

Attention Response: Mother attempts to orient child's attention toward herself in order to give child further information about the task.
Examples:
1. "Tom"
2. "hey, you"
3. [mother waves at child]
4. [mother pats child's hand]
5. "say..."

Orientation Response: Mother orients child's attention to some aspect of the task, breaking the task into units, but NOT specifying the exact action for the child. Can be declarative or interrogative.

Examples:
1. "same?"
2. "What shall we build first?"
3. "how many blacks do you see here?"
4. [mother taps block]
5. [mother points]
6. "Let's look at the front of the house"
7. "Can you see this house"

AFFECT

+ Positive: Mother's voice or actions or posture indicate approval of child and/or child's actions.

- Negative: Mother's voice or actions or posture indicate disapproval of child and/or child's actions.

0 Neutral: Mother's voice, actions or posture indicate neither positive nor negative feelings about the child or child's actions.

SPECIFICITY

One: Exact location, block or nature of information is not apparent from mother's language or gesture.
Mother waves, clears throat, etc. to get child's attention.
Approval or disapproval is general, not directed to specific procedure or act of child.

Examples:
1. "Come on, now"
2. [mother ignores child's dependency bid]
3. [mother smiles and nods]
4. "O.K."
5. "same?"
6. "where shall we start?"
7. [mother waves at child]
8. "look" [mother points to general area]
9. "looks like you're doing it O.K."
10. "no"

Two: Specific location, color, shape, size, or order, etc. is apparent from mother's language or gesture - but only one such term is used.
Mother uses non-specific terms or tugs at child's clothing to procure child's attention.
Approval or disapproval is given to progress in one area - color, shape, location, etc.

Examples:
1. "Find a red one"
2. "Put the roof on"
3. "you need more"
4. [mother holds two blocks out to child] (expecting child to take one)
5. [mother tugs at child's shirt]
6. "hey"
7. "good for you"
8. "yes, on top"

Three: Specific location, color, shape, size, order, in any combination of two or more is apparent from mother's language or gesture. Mother uses child's name or touches child to get child's attention Approval or disapproval is specific to any two of above terms, or involves use of child's name.

Examples:

1. [mother grabs child's arm]
2. [mother guides child's hand to a particular block]
3. "you need more blue blocks"
4. "there are blue blocks all around the bottom"
5. "Good, Johnny"
6. "Right, the red goes on top"
7. "Marta"

PART II. Child's Verbalizations and Actions

Compliance: Child complies with mother's suggestion, directives, solicitations or feedback.

Noncompliance: Child ignores or pursues other courses of action in response to mother's suggestions, directives, solicitations or feedback.

Dependence: Child solicits feedback from mother with respect to self or task.

Independence: Child acts independently of mother; utterances or actions are not dependent on anything the mother says or does.

Appendix B

Classification Task Score Sheet

Identity

1. jump rope, jump rope, wastebasket
2. bicycle, bicycle, glass
3. giraffe, giraffe, girl
4. butterfly, butterfly, tree

Similarity

1. $girl_1^1$, $girl_1^2$, newspaper
2. $fish^1$, $fish^2$, kleenex
3. dog^1, dog^2, airplane
4. $zebra^1$, $zebra^2$, cookie jar
5. $book^1$, $book^2$, telephone

Superordinate/No Association

1. tiger, kangaroo, bowl
2. drum, trumpet, candle
3. sweater, dress, suitcase
4. ball, teddy bear, glasses
5. spider, caterpiller, door
6. apple, banana, mouse
7. soda, milk, scissors
8. stove, washing machine, kite
9. leaf, flower, lamp
10. frying pan, cooking pot, turkey
11.* $doll^1$, $doll^2$, flower

Superordinate/Association

1. doghouse, house, dog
2. firetruck, garbage truck, fireman
3. girl, baby, rattle
4. flower, tree, bee
5. hammer, saw, nail
6. parakeet, woodpecker, bird cage
7. dress, pants, boy
8. cow, barn, tiger
9. iron, toaster, clothes
10. ice cream, cookies, spoon
11.* $rabbit^1$, $rabbit^2$, skate

* check items

Superordinate/Subordinate

1. elephant, lion, toucan
2. peas, corn, strawberry
3. pig, horse, squirrel
4. cake, pie, bread
5. chair, sofa, bed
6. man, man, boy
7. wagon, buggy, blocks
8. car, truck, boat
9. shovel, rake, screwdriver
10. spatula, mixing spoon, cup
11.* snake[1], snake[2], ruler

* check items

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_____ B. Best, & G. Roberts. Cognitive development in young deaf children. Research Report #92. August 1975.

_____ C. R. Clark, D. F. Moores, & R. W. Woodcock. MELDS: Teacher's Manual. Development Report #4. August 1975.

_____ C. R. Clark, D. F. Moores, & R. W. Woodcock. MELDS: Parent's Manual. Development Report #5. August 1975.

_____ R. Wozniak, & B. Egeland. Learning to look and listen; A visual information processing training program. Research Report #91. August 1975.

_____ J. Nelson, J. Troup, M. Thurlow, P. Krus, & J. Turnure. An assessment of the effectiveness of the Money, Measurement and Time Program for TMR students. Research Report #90. May 1975.

_____ W. Charlesworth, M. Kreutzer, & L. Kjergaard. Communication during problem solving in high-risk and normal preschool children. Occasional Paper #33. May 1975.

_____ J. Turnure & M. Thurlow. Relations and the effectiveness of verbal elaborations. Research Report #89. May 1975.

_____ M. Thurlow, J. Turnure, A. Taylor, P. Krus, R. Howe, & J. Troup. An assessment of the effectiveness of the Money, Measurement and Time Program for EMR children. Research Report #88. March 1975.

_____ K. Hesse, J. Turnure, & N. Buium. Down's syndrome children's early comprehension of WH questions asked in naturalistic and experimental settings. Research Report #87. March 1975.

_____ M. Thurlow, R. Howe, P. Krus, A. Taylor, & J. Turnure. Time with the Calendar Unit: A formative evaluation. Research Report #86. February 1975.

_____ M. Thurlow, P. Krus, R. Howe, A. Taylor, & J. Turnure. Measurement of Length Unit: A formative evaluation. Research Report #85. February 1975.

_____ P. Krus, R. Howe, M. Thurlow, A. Taylor, & J. Turnure. Time with the Clock Unit: A formative evaluation. Research Report #84. February 1975.

_____ K. Hesse, J. Turnure, & N. Buium. The comprehension and production of interrogatives in the language of normal and retarded children: A review and analysis. Occasional Paper #32. February 1975.

_____ B. Egeland, R. Wozniak, & A. Thibodeau. Visual information processing training program experimental version. Development Report #3. January 1975.

_____ R. Hoffmeister, D. Moores, & R. Ellenberger. The parameters of sign language defined: Translation and definition rules. Research Report #83. January 1975.

_____ J. Turnure, N. Buium, & M. Thurlow. The production deficiency model of verbal elaboration: Some contrary findings and conceptual complexities. Research Report #82. January 1975.

_____ D. Moores, K. Weiss, & M. Goodwin. Evaluation of programs for hearing impaired children: Report of 1973-74. Research Report #81. December 1974.

_____ D. Moores, S. Fisher, & M. Harlow. Post-secondary programs for the deaf: VI. Summary and Guidelines. Research Report #80. December 1974.

_____ M. Harlow, S. Fisher, & D. Moores, Post-secondary programs for the deaf: V. Follow-up Data Analysis. Research Report #79. December 1974.

_____ R. Wozniak. Psychology and education of the learning disabled child in the Soviet Union. Research Report #78. December 1974.

_____ M. Thurlow, P. Krus, R. Howe, A. Taylor, & J. Turnure. Measurement of Weight Unit: A formative evaluation. Research Report #77. December 1974.

_____ M. Thurlow, P. Krus, R. Howe, A. Taylor, & J. Turnure. Money Unit: A formative evaluation. Research Report #76. December 1974.

_____ M. Harlow, D. Moores, & S. Fisher. Post-secondary programs for the deaf: IV. Empirical Data Analysis. Research Report #75. December 1974.

_____ C. Mueller & S. Samuels. Initial field test and feasibility study of the hypothesis/test word recognition procedures in the special education classroom. Research Report #74. December 1974.

_____ P. Krus, M. Thurlow, J. Turnure, & A. Taylor. Summative evaluation of the Time with the Clock Unit of the Money, Measurement and Time Program. Research Report #73. October 1974.

_____ P. Krus, M. Thurlow, J. Turnure, & A. Taylor. Summative evaluation of the Measurement of Weight Unit of the Money, Measurement and Time Program. Research Report #72. October 1974.

_____ P. Krus, M. Thurlow, J. Turnure, & A. Taylor. Summative evaluation of the Measurement of Length Unit of the Money, Measurement and Time Program. Research Report #71. October 1974.

_____ P. Krus, M. Thurlow, J. Turnure, & A. Taylor. Summative evaluation of the Money Unit of the Money, Measurement, and Time Program. Research Report #70. October 1974.

_____ P. Krus, M. Thurlow, J. Turnure, A. Taylor & R. Howe. The formative evaluation design of the Vocabulary Development Project. Occasional Paper #31. October 1974.

_____ D. Krus, K. Balcar & P. Bland. ECHO: A computer based test for the measurement of individualistic, cooperative, defensive and aggressive modes of behavior. Occasional Paper #30. September 1974.

____ J. Rynders, J. Horrobin, L. Wangsness & J. Swanson. The severe nature of verbal learning deficits in preschool Down's syndrome (Mongoloid) children. Research Report #69. August 1974.

____ R. Riegel. Reliability of children's sorting strategies using alternative forms of the SORTS test. Research Report #68. August 1974.

____ S. Fisher, D. Moores, & M. Harlow. Post-secondary programs for the deaf: III. Internal view. Research Report #67. September 1974.

____ W. Bart. A set-theoretic model for the behavioral classification of environments. Occasional Paper #29. July 1974.

* D. Ktus, W. Bart & P. Airasian. Ordering theory and methods. Occasional Paper #28. July 1974.

____ B. Egeland & A. Thibodeau. Selective attention of impulsive and reflective children. Research Report #66. July 1974.

____ R. Hoffmeister, B. Best & D. Moores. The acquisition of sign language in deaf children of deaf parents: Progress Report. Research Report #65. June 1974.

____ P. Krus. Use of family history data to predict intellectual and educational functioning longitudinally from ages four to seven. Research Report #64. June 1974.

____ P. Krus. Analyzing for individual differences in evaluating compensatory education programs. Occasional Paper #27. June 1974.

____ J. Rondal. The role of speech in the regulation of behavior. Research Report #63. June 1974.

____ N. Buium, J. Rynders & J. Turnure. A semantic-relational-concept based theory of language acquisition as applied to Down's syndrome children: Implication for a language enhancement program. Research Report #62. May 1974. (Journal of Speech and Hearing Disorders, in press)

____ S. Fisher, M. Harlow, & D. Moores. Post-secondary programs for the deaf: II. External view. Research Report #61. March 1974.

____ D. Moores, M. Harlow, & S. Fisher. Post-secondary programs for the deaf: I. Introduction and overview. Research Report #60. February 1974.

____ D. Krus. Synopsis of basic theory and techniques of order analysis. Occasional Paper #26. April 1974.

____ S. Samuels, J. Spiroff & H. Singer. Effect of pictures and contextual conditions on learning to read. Occasional Paper #25. March 1974.

____ A. Taylor, M. Thurlow, & J. Turnure. Elaboration as an instructional technique in the vocabulary development of EMR children. Research Report #59. March 1974.

_____ N. Buium & J. Turnure. The universality of self-generated verbal mediators as a means of enhancing memory processes. Research Report #58. January 1974.

_____ D. Moores, K. Weiss & M. Goodwin. Evaluation of programs for hearing impaired children: Report of 1972-73. Research Report #57. December 1973.

_____ J. Turnure, W. Charlesworth, D. Moores, J. Rynders, M. Horrobin, S. Samuels, & R. Wozniak. American Psychological Association Symposium Papers. Occasional Paper #24. December 1973.

_____ N. Buium. Interrogative types of parental speech to language learning children: a linguistic universal? Research Report #56. December 1973.

_____ D. Krus. An outline of the basic concepts of order analysis. Occasional Paper #23. February 1974.

_____ D. Krus. Order analysis: A fortran program for generalizable multidimensional analysis of binary data matrices. Occasional Paper #22. November 1973.

_____ W. Bart. The pseudo-problem of IQ. Occasional Paper #21. October 1973.

_____ J. Turnure & M. Thurlow. Verbal elaboration and the enhancement of language abilities in the mentally retarded: The role of interrogative sentence-forms. Occasional Paper #20. October 1973. (Proceedings of the International Association for the Scientific Study of Mental Deficiency, in press.)

_____ P. Dahl, S. Samuels & T. Archwamety. A mastery based experimental program for teaching poor readers high speech word recognition skills. Research Report #55. September 1973.

_____ R. Riegel, F. Danner & L. Donnelly. Developmental trends in the generation and utilization of associative relations for recall by EMR and non-retarded children: The SORTS test. Research Report #54. August 1973.

_____ R. Hoffmeister & D. Moores. The acquisition of specific reference in the linguistic system of a deaf child of deaf parents. Research Report #53. August 1973.

_____ W. Bart & M. Smith. An interpretative framework of cognitive structures. Occasional Paper #19. June 1973.

_____ C. Clark & J. Greco. MELDS (Minnesota Early Language Development Sequence) glossary of rebuses and signs. Occasional Paper #18. June 1973.

_____ J. Turnure. Interrelations of orienting response, response latency and stimulus choice in children's learning. Research Report #52. May 1973.

* S. Samuels & P. Dahl. Automaticity, reading and mental retardation. Occasional Paper #17. May 1973.

* S. Samuels & P. Dahl. Relationships among IQ, learning ability, and reading achievement. Occasional Paper #16. May 1973.

_____ N. Buium & J. Rynders. The early maternal linguistic environment of normal and Down's syndrome (Mongoloid) language learning children. Research Report #51. May 1973. (American Journal of Mental Deficiency (with Turnure), July 1974, 79, 52-58.)

____ T. Archwamety & S. Samuels. A mastery based experimental program for teaching mentally retarded children word recognition and reading comprehension skills through use of hypothesis/test procedures. Research Report #50. May 1973.

____ W. Bart. The process of cognitive structure complexification. Research Report #49. April 1973.

* B. Best. Classificatory development in deaf children: Research on language and cognitive development. Occasional Paper #15. April 1973.

____ R. Riegel, A. Taylor & F. Danner. The effects of training in the use of grouping strategy on the learning and memory capabilities of young EMR children. Research Report #48. April 1973.

____ J. Turnure & M. Thurlow. The latency of forward and backward association responses in an elaboration task. Research Report #47. March 1973.

____ R. Riegel & A. Taylor. Strategies in the classroom: A summer remedial program for young handicapped children. Occasional Paper #14. March 1973.

____ D. Moores. Early childhood special education for the hearing impaired. Occasional Paper #13. February 1973.

* R. Riegel & A. Taylor. A comparison of conceptual strategies for grouping and remembering employed by educable mentally retarded and non-retarded children. Research Report #46. February 1973. (American Journal of Mental Deficiency, March 1974, 78, 592-598.)

____ J. Rynders. Two basic considerations in utilizing mothers as tutors of their very young retarded or potentially retarded children. Occasional Paper #12. January 1973.

____ R. Bruininks, J. Rynders & J. Gross. Social acceptance of mildly retarded pupils in resource rooms and regular classes. Research Report #45. January 1973. (American Journal of Mental Deficiency, January 1974, 78, 377-383.)

____ J. Turnure & M. Thurlow. The effects of interrogative elaborations on the learning of normal and EMR children. Research Report #44. January 1973.

____ J. Turnure & S. Samuels. Attention and reading achievement in first grade boys and girls. Research Report #43. November 1972. (Journal of Educational Psychology, 1974, 66, 29-32).

* R. Riegel, A. Taylor, S. Clarren, & F. Danner. Training educationally handicapped children to use associative grouping strategies for the organization and recall of categorizable materials. Research Report #42. November 1972.

* R. Riegel, F. Danner, & A. Taylor. Steps in sequence: Training educationally handicapped children to use strategies for learning. Development Report #2. November 1972.

_____ A. Taylor, M. Thurlow & J. Turnure. The teacher's introduction to: The Math Vocabulary Program. Development Report #1. March 1973.

_____ J. Turnure & M. Thurlow. The effects of structural variations in elaboration on learning by normal and EMR children. Research Report #41. September 1972. (American Journal of Mental Deficiency, 1975, 79, in press.)

_____ A. Taylor & N. Bender. Variations of strategy training and the recognition memory of EMR children. Research Report #40. September 1972. (Bender, N. & Taylor, A. Instructional Treatments Based on Learning Strategies and the Recognition Memory of Retarded Children. American Educational Research Journal, 1973, 10(4), 337-343).

* D. Moores, C. McIntyre, & K. Weiss. Evaluation of programs for hearing impaired children: Report of 1971-72. Research Report #39. September 1972.

_____ R. Rubin. Follow-up of applicants for admission to graduate programs in special education. Occasional Paper #11. July 1972.

_____ D. Moores. Communication -- Some unanswered questions and some unquestioned answers. Occasional Paper #10. July 1972.

_____ A. Taylor & S. Whitely. Overt verbalization and the continued production of effective elaborations by EMR children. Research Report #38. June 1972. (Whitely, S. & Taylor, A. American Journal of Mental Deficiency, 1973, 78(2), 193-198).

_____ R. Riegel. Measuring educationally handicapped children's organizational strategies by sampling overt groupings. Research Report #37. May 1972.

_____ E. Gallistel, M. Boyle, L. Curran, & M. Hawthorne. The relation of visual and auditory aptitudes to first grade low readers' achievement under sight-word and systematic phonic instruction. Research Report #36. May 1972.

_____ E. Gallistel & P. Fischer. Decoding skills acquired by low readers taught in regular classrooms using clinical techniques. Research Report #35. May 1972.

_____ J. Turnure & M. Thurlow. Verbal elaboration in children: Variations in procedures and design. Research Report #34. March 1972. (Study I: Journal of Genetic Psychology, in press).

_____ D. Krus & W. Bart. An ordering-theoretic method of multidimensional scaling of items. Research Report #33. March 1972.

_____ J. Turnure & S. Larsen. Effects of various instruction and reinforcement conditions on the learning of a three-position oddity problem by nursery school children. Research Report #32. March 1972.

____ J. Turnure & S. Larsen. Outerdirectedness in mentally retarded children as a function of sex of experimenter and sex of subject. Research Report #31. March 1972.

____ J. Rynders & M. Horrobin. A mobile unit for delivering educational services to Down's Syndrome (Mongoloid) infants. Research Report #30. January 1972. (Presented at Council for Exceptional Children, Special National Conference, Memphis, December, 1971.)

* F. Danner & A. Taylor. Pictures and relational imagery training in children's learning. Research Report #29. December 1971.

____ J. Turnure & M. Thurlow. Verbal elaboration phenomena in nursery school children. Research Report #28. December 1971. (Study II: Proceedings of 81st Annual Convention of the American Psychological Association, 1973, 83-84.)

____ D. Moores & C. McIntyre. Evaluation of programs for hearing impaired children: Progress report 1970-71. Research Report #27. December 1971.

____ S. Samuels. Success and failure in learning to read: A critique of the research. Occasional Paper #9. November 1971. (In M. Kling, The Literature of Research in Reading with Emphasis on Modes, Rutgers University, 1971.) (In Reading Research Quarterly, 1973, 8(2), 200-239.)

* S. Samuels. Attention and visual memory in reading acquisitions. Research Report #26. November 1971.

* J. Turnure & M. Thurlow. Verbal elaboration and the promotion of transfer of training in educable mentally retarded children. Research Report #25. November 1971. (Journal of Experimental Child Psychology, 1973, 15, 137-148.)

* A. Taylor, M. Josberger & S. Whitely. Elaboration training and verbalization as factors facilitating retarded children's recall. Research Report #24. October 1971. (Journal of Educational Psychology, 1973, 64, 341-346.)

____ W. Bart & D. Krus. An ordering-theoretic method to determine hierarchies among items. Research Report #23. September 1971.

____ A. Taylor, M. Josberger & J. Knowlton. Mental elaboration and learning in retarded children. Research Report #22. September 1971. (Mental Elaboration and Learning in EMR children. American Journal of Mental Deficiency, 1972, 77, 69-76.)

____ J. Turnure & S. Larsen. Outerdirectedness in educable mentally retarded boys and girls. Research Report #21. September 1971. (American Journal of Mental Deficiency, 1973, 78, 163-170.)

____ R. Bruininks, T. Glaman & C. Clark. Prevalency of learning disabilities: Findings, issues, and recommendations. Research Report #20. June 1971. (Presented at Council for Exceptional Children Convention, Miami Beach, April 1971.)

____ M. Thurlow & J. Turnure. Mental elaboration and the extension of mediational research: List length of verbal phenomena in the mentally retarded. Research Report #19. June 1971. (Journal of Experimental Child Psychology, 1972, 14, 184-195.)

____ G. Siegel. Three approaches to speech retardation. Occasional Paper #8. May 1971.

* D. Moores. An investigation of the psycholinguistic functioning of deaf adolescents. Research Report #18. May 1971. (Exceptional Children, 1970, 36, 645-652.)

* D. Moores. Recent research on manual communication. Occasional Paper #7. April 1971. (Keynote Address, Division of Communication Disorders, Council for Exceptional Children Annual Convention, Miami Beach, April 1971.)

____ J. Turnure, S. Larsen & M. Thurlow. Two studies on verbal elaboration in special populations. I. The effects of brain injury; II. Evidence of transfer of training. Research Report #17. April 1971. (Study I: American Journal of Mental Deficiency, 1973, 78, 70-76.)

____ R. Bruininks & J. Rynders. Alternatives to special class placement for educable mentally retarded children. Occasional Paper #6. March 1971. (Focus on Exceptional Children, 1971, 3, 1-12.)

____ D. Moores. Neo-oralism and the education of the deaf in the Soviet Union. Occasional Paper #5. February 1971. (Exceptional Children, 1972, 39, 377-384.)

____ D. Feldman, B. Marrinan & S. Hartfeldt. Unusualness, appropriateness, transformation and condensation as criteria for creativity. Research Report #16. February 1971. (American Educational Research Association Annual Conference, New York, February 1971.)

____ P. Broen & G. Siegel. Variations in normal speech disfluencies. Research Report #15. January 1971. (Language & Speech, 1972, 15, 219-231.)

* D. Feldman. Map understanding as a possible crystallizer of cognitive structures. Occasional Paper #4. January 1971. (American Educational Research Journal, 1971, 3, 484-502.)

* J. Rynders. Industrial arts for elementary mentally retarded children: An attempt to redefine and clarify goals. Occasional Paper #3. January 1971.

____ D. Moores. Education of the deaf in the United States. Occasional Paper #2. November 1970. (Moscow Institute of Defectology, 1971, published in Russian.)

R. Bruininks & C. Clark. Auditory and learning in first-, third-, and fifth-grade children. Research Report #14. November 1970.

R. Bruininks & C. Clark. Auditory and visual learning in first grade educable mentally retarded normal children. Research Report #13. November 1970. (American Journal of Mental Deficiency, 1972, 76(5), 561-567.)

R. Bruininks. Teaching word recognition to disadvantaged boys with variations in auditory and visual perceptual abilities. Research Report #12. November 1970. (Journal of Learning Disabilities, 1970, 3, 30-39).

R. Bruininks & W. Lucker. Change and stability in correlations between intelligence and reading test scores among disadvantaged children. Research Report #11. October 1970. (Journal of Reading Behavior, 1970, 2, 295-305.)

R. Rubin. Sex differences in effects of kindergarten attendance on development of school readiness and language skills. Research Report #10. October 1970. (Elementary School Journal, 72(5), February 1972.)

R. Rubin & B. Balow. Prevalence of school learning and behavior disorders in a longitudinal study population. Research Report #9. October 1970. (Exceptional Children, 1971, 38, 293-299.)

D. Feldman & J. Bratton. On the relativity of giftedness: An empirical study. Research Report #8. August 1970. (American Educational Research Annual Conference, New York, February 1971.)

J. Turnure, M. Thurlow & S. Larsen. Syntactic elaboration in the learning and reversal of paired-associates by young children. Research Report #7. January 1971. (Study II: Journal of Genetic Psychology, in press.)

R. Martin & L. Berndt. The effects of time-out on stuttering in a 12-year-old boy. Research Report #6. July 1970. (Exceptional Children, 1970, 37, 303-304.)

J. Turnure & M. Walsh. The effects of varied levels of verbal mediation on the learning and reversal of paired associates by educable mentally retarded children. Research Report #5. June 1970. (Study I: American Journal of Mental Deficiency, 1971, 76, 60-67. Study II: American Journal of Mental Deficiency, 1971, 76, 306-312.)

J. Turnure, J. Rynders, & N. Jones. Effectiveness of manual guidance, modeling and trial and error learning for inducing instrumental behavior in institutionalized retardates. Research Report #4. June 1970. (Merrill-Palmer Quarterly, 1973, 19, 49-65.)

J. Turnure. Reactions to physical and social distractors by moderately retarded institutionalized children. Research Report #3. June 1970. (Journal of Special Education, 1970, 4, 283-294.)

* D. Moores. Evaluation of preschool programs: An interaction analysis model. Occasional Paper #1. April 1970. (Keynote Address, Diagnostic Pedagogy, International Congress on Deafness. Stockholm, August 1970; also presented at American Instructors of the Deaf Annual Convention, St. Augustine, Florida, April 1970.)

____ D. Feldman & W. Markwalder. Systematic scoring of ranked distractors for the assessment of Piagetian reasoning levels. Research Report #2. March 1970. (Educational and Psychological Measurement, 1971, 31, 347-362.)

____ D. Feldman. The fixed-sequence hypothesis: Individual differences in the development of school related spatial reasoning. Research Report #1. March 1970.

* Out of print